REMARKS

Claims 1, 3-8, and 13 are pending herein.

I. The obviousness rejections based on Zimmerman (US 6,481,648) in view of Takahashi (US 6,412,925).

The USPTO respectfully rejects claims 1-7, 12 and 13 under 35 U.S.C. §103(a) as being obvious over Zimmerman in view of Takahashi. Claim 1 is an independent claim, and claims 2 and 12 have been cancelled.

A. The cited references do not teach or suggest a nozzle having an inside diameter of the edge portion of the nozzle being more than 0.2 μm and being not more than 4 μm, as claimed in claim 1.

Claim 1 claims in relevant part:

> "a liquid jetting head comprising a nozzle to jet the droplet from an edge portion, **an inside diameter of the edge portion of the nozzle being more than 0.2 μm and being not more than ~~8μm~~4 μm**, and at least the edge portion of the nozzle being formed with insulating material." **(emphasis added)**

No new matter is introduced by these amendments. Support for the amendments can be found on pages 14 and 23-25 of the present specification and in present Figures 8-10. Regarding these limitations, it is respectfully not seen where the cited references teach or suggest the claimed structure quoted above.

Specifically, as the USPTO respectfully notes on page 2 of the Office Action, "**Zimmerman does not specifically disclose that an inside diameter of the edge portion being 8 micrometers [or] 4 micrometers" (emphasis added)**. The USPTO respectfully attempts to overcome this deficiency in Zimmerman by citing Takahashi at column 2, lines 44-49, which states:

> "Recently, demands for higher printing resolutions have increased in order to improve print quality. To respond to such demands, it is preferable to reduce the ink droplet volume. The ink droplet volume is usually reduced by reducing the nozzle diameter or by reducing the drive voltage."

The USPTO relies on this **overly broad generalization** to allegedly teach or suggest the **specifically claimed limitation** of an inside diameter of a nozzle being not more than 4 μm.

However, applicants respectfully note that **Takahashi never expressly discloses the specific inside diameter of more than 0.2 μm and not more than 4 μm,** as claimed in claim 1. In fact, the only nozzle diameter that Takahashi does is found at column 6, lines 37-38, which states: "[e]ach of the nozzles 618 is tapered and 25 μm in diameter on the ink ejecting side." **This nozzle diameter of 25 μm is clearly well outside the specifically claimed nozzle diameter range of more than 0.2 μm and not more than 4 μm.**

Overall, it is respectfully important to reiterate that **none of the cited references expressly teaches or suggests a nozzle diameter in the specifically claimed range of claim 1.** It is respectfully noted that **Takahashi expressly teaches only a nozzle diameter of 25 μm**, at column 6, lines 37-38.

In contrast, present Figure 12A illustrates one possible embodiment of the claimed structure quoted above. Specifically, as noted on page 31 of the present specification, **an inside diameter D_I of the in-nozzle passage 52 is set to 1 μm** to perform concentration of the electric field due to the super miniaturized nozzle. Thus, in-nozzle passage 52 having inside diameter D_I is one example of a nozzle having an inside diameter of the edge portion of the nozzle being more than 0.2 μm and being not more than 4 μm, as claimed in claim 1.

The claimed structure quoted above is important and non-trivial because it provides significant **inherent** advantages over conventional structures. For example, as noted on page 23 of the present specification and shown in present Figure 8, the apparatus of claim 1 jets ink droplets in a state of high maximum electric field intensity. Thus, **the jetted micro-droplets can have improved flight stability, landing accuracy, and jetting responsiveness.**

Furthermore, as noted on pages 24-25 of the present specification and in present Figure 9, the ratio of the jetting start voltage to rayleigh limit voltage becomes greater than 0.6 when the nozzle inside diameter is within the specifically claimed range of claim 1. As a result, **the claimed structure quoted above can achieve superior charge efficiency of the droplets.**

Additionally, as shown in present Figure 10, **if the nozzle inside diameter is less than 0.2 μm, the electric field concentrated area is extremely small.** As a result, **insufficient electrostatic force is applied to the jetted droplet, resulting in lower flight stability.** In contrast, **if the inner nozzle diameter is within the specifically claimed range, the jetting is sufficiently accelerated by the action of electric field concentration so that the flight of the droplet is stabilized.**

In summary, **the cited references do not explicitly teach a nozzle having an inside diameter of the edge portion of the nozzle being more than 0.2 μm and being not more than 4 μm**, as claimed in claim 1. Furthermore, as noted above, the specifically claimed nozzle diameter range of claim 1 results in **significant, inherent advantages**, and thus, the claimed range is **more than a mere design option.**

Thus, it is respectfully asserted that the cited references, taken either alone or in combination, do not teach or suggest all the claimed limitations of claim 1. Therefore, it is respectfully asserted that claim 1 is not obvious over the cited references.

B. The USPTO's obviousness rejections impermissibly rely on an "obvious to try" rationale.

On page 3 of the Office Action, the USPTO respectfully states:

> "It would have been obvious to one of ordinary skill in the art at the time of the applicant's invention to reduce the size of the inside diameter of the edge portion of the nozzle of Zimmerman, to 8 or even 4 micrometers in order to increase the printing resolution as taught by Takahashi."

At most, **the USPTO's proposed modification of Zimmerman constitutes an impermissible "obvious to try" rationale.** MPEP 2145 X.B cites a number of cases establishing that it is "improper" to rely on an "obvious to try" rationale in an obviousness analysis. At best, **Takahashi only teaches in very broad, general terms that a person could improve resolution by reducing nozzle diameter.** Thus, the mere fact that Takahashi teaches that reducing nozzle diameter improves resolution is respectfully **insufficient to teach the specifically claimed limitation of a nozzle diameter being more than 0.2 μm and being not more than 4 μm**, as claimed in claim 1.

Thus, it is respectfully asserted that the USPTO has improperly relied on an "obvious to try rationale," and therefore it is further respectfully asserted that claim 1 is not obvious over the cited references.

C. Additional explanation.

Applicants respectfully submit the following additional explanation regarding the cited references.

As discussed above, a smaller nozzle inside diameter is not always better. In other words, there is a lower limit to the nozzle inside diameter range, beyond which the inherent advantages of the apparatus of claim 1 cannot be realized. For example, as noted above, **if the nozzle inside diameter is less than 0.2 μm, the electric field concentrated area is extremely small.** As a result, **insufficient electrostatic force is applied to the jetted droplet, resulting in lower flight stability.** Thus, the specifically claimed range of the inside diameter of the nozzle has a lower limit of 0.2 μm.

In contrast, Takahashi only discloses reducing the size of the nozzle inside diameter, and **neither Takahashi nor Zimmerman teach or suggest a lower limit of the nozzle inside diameter in an ink-jet print that jets droplets by the action of electrostatic forces.**

Additionally, Zimmerman discloses a micro-spray of electrostatic type for introducing a sample to a mass spectrometer. Furthermore, Zimmerman only discloses a nozzle outer diameter of 10-100 μm, and does not teach or suggest the specifically claimed nozzle inside diameter range of 0.2 μm to 4 μm, as claimed in claim 1.

D. The dependent claims.

As noted above, it is respectfully asserted that independent claim 1 is allowable, and therefore it is further respectfully asserted that dependent claims 3-7 and 13 are also allowable.

II. The accompanying IDS.

Applicants respectfully note that an IDS has been filed with this Amendment that includes an Office Action issued to JP application no. 2003-293055 (i.e., the foreign priority application for the present application), and the references cited in the Office Action.

Regarding the foreign Office Action, Applicants respectfully note that the Examiner of the JP '055 application misread one of the references regarding the inside nozzle diameter. Specifically, in the Office Action for the JP '055 application, it is alleged that JP 2002-172787A (reference 6) discloses the nozzle inner diameter of 5-120 μm (see page 3, line 9 of the translation). However, **JP '787 actually discloses a cross sectional area of an opening of 100-40000 μm^2**, and the diameter calculated from the cross section area is 10-240 μm. Therefore, the "nozzle inner diameter of 5-120 μm" of the Office Action is a technical error and should be read as "nozzle inner **radius** of 5-120 μm."

III. Conclusion.

Reconsideration and allowance of all of the claims is respectfully requested.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130.

Please contact the undersigned for any reason. Applicants seek to cooperate with the Examiner including via telephone if convenient for the Examiner.

Respectfully submitted,

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